SWINGLE CLINIC

# POTENTIATING NEUROTHERAPY: TECHNIQUES FOR STIMULATING THE EEG

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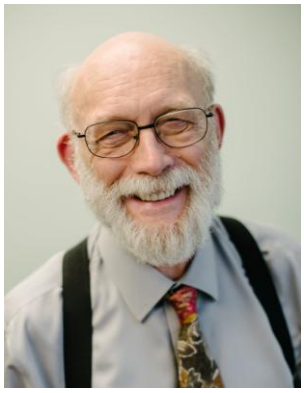

Since concentrating on neurotherapy as my primary therapeutic tool, my research has focused on developing techniques for increasing the efficiency and accelerating the process of modifying brain functioning. Many neurotherapists do provide clients with various adjunctive self-administered treatments to facilitate the therapeutic process. These "add ons" include relaxation exercises, self-hypnosis, energy psychology routines, life style modification recommendations, subliminal affirmation devices, cranial microamperage stimulators, audiovisual stimulators and therapeutic harmonics. The reason for prescribing these procedures, of course, is because they are believed to potentiate the therapeutic process.

I have been particularly interested in the use of therapeutic harmonics and I have been doing research in this area for almost 20 years. One such harmonic (Alert) is a blend of several carrier frequencies providing a 10 Hz overriding frequency that is imbedded in a filtered pink noise at between –15 and –25 dB(C). The effect of the Alert harmonic is that it suppresses EEG theta (3-7 Hz) amplitude (Swingle, 1996) and has been found to markedly accelerate the neurotherapeutic treatment of Common Attention Deficit Disorder (CADD) (Swingle, 2001). The Alert harmonic has been used by thousands of clients and is marketed by several companies. The data on this harmonic are very consistent. The suppressing effect is about the same with males and females (provided the sound pressure levels are presented at gender specific levels - see Swingle, 1992), but differs with age. For clients over 18 the suppression of theta amplitude is about 30% whereas for young children the suppression is about 15%.

It is not surprising that sound influences brain activity and further research has identified a number of harmonic blends that have specific effects on the EEG such as reducing beta amplitude or increasing theta amplitude and thus can be very useful as adjunctive treatments for sleep or anxiety difficulties. Harmonics have also been developed to enhance the Sensory Motor Rhythm (SMR) and slower frequencies, suppress high frequencies (28-40Hz) and to speed up alpha.

When working with subtle energy such as subliminal harmonics, it is important to prepare the stimuli so that they are within the effective range. In the case of sound, the effective range is very specific and narrow (techniques for preparing such materials are described in Swingle, 1992). If the sound is too close to supraliminal levels the information is not processed. This "gray zone" is found not only with sound but with other modalities as well (Gary Schwartz, personal communication, reported this gray zone with olfaction). This suggests two independent processing systems for information above and below perceptual thresholds and importantly, an energy level zone in which the information is not processed efficiently in either system. The second finding suggesting that subtle energy may be processed differently from more potent stimulation is that identical stimuli produce different effects supraliminally versus subliminally. For example, when presented at 15dB(C) below ambient, a 10 Hz harmonic increases heart rate whereas a 25 Hz harmonic at the same intensity reduces heart rate, which is the opposite of what one would expect with supraliminal presentation of these same frequencies (Ohatrian et al, 1960, Swingle, 1993).

The adjunctive treatment procedures described above are static in the sense that they are applied to have a specific effect on autonomic and/or central nervous system functioning. The Alert harmonic, for example, is

prescribed for home use by a CADD child because at intake it has been determined that this stimulation will reduce theta amplitude for this person.

My research into braindriving technologies was stimulated by a long acquaintance with Len Ochs. As many readers know, Dr. Ochs was one of the pioneers in the development of stimulated EEG treatment procedures. Dr. Ochs demonstrated that making supraliminal light stimulation (Light Emitting Diodes (LEDs) mounted on eyeglass frames) contingent on EEG activity could be an effective neurotherapeutic treatment for a variety of disorders. At this same time I was heavily into research on subliminal energy treatment procedures as adjuncts to neurotherapy. Interestingly, Len Ochs discovered at about this same time that the energy from the LEDs (with the lights completely blocked) was a more powerful treatment than when the lights were seen by the client! Given the theta suppressing effect of the Alert harmonic it seemed logical to use that harmonic to modify brainwave amplitudes by making the sound contingent on EEG events in a manner similar to that introduced by Len Ochs.

At the present time, there are two products for delivering harmonics contingent on EEG or other biofeedback events. One is a software product and the second is a stand-alone unit that will deliver stimuli contingent on biofeedback events. The software product is called Braindryvr and is a program used in the Brainmaster EEG system. The second product is the Braindryvr Cascade, which is used with any EEG feedback system. This unit can deliver sound, or other stimuli, contingent on many quantitative and qualitative EEG events. The unit can be used with any biofeedback instrument with sound feedback capability but the present paper will be limited to the EEG.

It would perhaps be useful at this point to offer a few examples of stimulating or braindriving the EEG. The most straightforward example is a child with CADD in which the only remarkable feature of the QUICKQ (more about this below) is high amplitude theta activity over the sensory motor cortex (location Cz). The usual treatment for this condition is theta inhibit, beta enhance neurofeedback over location Cz. The number of sessions required to treat this disorder using “conventional” neurofeedback is between 40 and 80 (Lubar, 1991). One can reliably and permanently remediate this simplest form of ADD in 15 to 20 sessions using braindriving technology (Swingle, 2001). In between one third and one half of the neurotherapy sessions braindriving is included. When theta amplitude is below the training threshold the game icons move and the child hears the reward tone. When the theta amplitude goes above the training threshold then the game icons stop moving, the child does not hear the reward tone but the Braindryvr theta suppressing harmonic (in this case, Alert) is presented which suppresses theta amplitude.

A more complicated example is in the treatment of seizure disorders. Again, the conventional treatment for epilepsy is to enhance the amplitude and/or frequency of SMR operant responses over the sensory motor cortex (locations C3, Cz, C4). One should also set an inhibit on theta because if theta amplitude increases when the SMR amplitude increases, there is a likelihood that seizure activity will remain unchanged or become worse even though SMR amplitude is increasing (Lubar and Bahler, 1976). Using braindriving technology one can cascade the units so the theta-suppressing harmonic is presented when theta amplitude increases above threshold and the SMR-enhancing harmonic is presented when SMR amplitude drops below threshold. The braindriving technology can be used alone (i.e., no visual feedback) or with visual feedback displays. In most cases, braindriving is not used exclusively in the treatment of any condition but is combined with conventional neurofeedback. This is a practical clinical decision since the method of researching this technology has been to add it to the neurotherapy and observe the changes in the EEG and determine if the enhancements are sustained in the ongoing neurotherapy treatment sessions. We have been systematically increasing the percentage of sessions in which braindriving technology is used. There have been cases in which braindriving has been used exclusively but these have been cases in which there were circumstances mitigating conventional neurotherapy. One of these cases will be discussed in detail later in this article.

In keeping with the philosophy of rapid and efficient neurotherapeutic treatment, I have developed a rapid intake brain assessment – the QUICKQ (a summary procedure sheet is appended). This rapid intake assessment

requires about 6.5 minutes of recording at 5 brain sites (O1, Cz, F3, Fz, F4). At locations Cz, O1, F3 and F4 three brainwave bands are recorded: Theta (3-7Hz), Alpha (8-12Hz) and Beta (16-25Hz). At Cz and O1 we measure Eyes Open (EO) and Eyes Closed (EC) and also we test the harmonics to be used in the Braindryvr to verify that they affect brainwave amplitude as expected. At the frontal locations all recordings are EC. The appended procedure sheet for the QUICKQ describes the assessment procedure and suggested clinical probes based on the acquired data. It should be noted that the QUICKQ is not used in cases where a full nineteen-site brain map is warranted. The following cases all proceeded from the QUICKQ in which, aside from identifying areas for treatment, the effectiveness of the harmonic sounds for modifying brainwave activity had been established.

## CASE GR

This young woman was under treatment for a severe anxiety disorder that manifested in eating difficulties and poor immune functioning as evidenced by incessant colds and flus. Of several areas requiring treatment, one prominent brainwave feature was a markedly deficient theta/beta ratio at location O1. Her ratio was .54 whereas normative would be around 2.00. The neurotherapeutic treatment for this condition is to enhance theta amplitude and/or decrease beta amplitude at location O1. Generally, one does not commence treatment with these brainwave bands nor at that exact location but gradually approach the training bandwidths and locations starting in areas and with bands that are easier for the client to master. However, this is beyond the scope of this paper; suffice it to say that the following example of braindriving occurred at the time when the client was ready for theta amplitude enhancement. In keeping with the strategy stated above of approaching the treatment frequency with more manageable (for the client) frequencies, we started with braindriving alpha (8-12Hz). The potentiating harmonic for alpha amplitude enhancement is 6 to 8 cycles per minute that is presented to the client anytime alpha amplitude drops below the training threshold. The baseline alpha amplitude was 3.2 microvolts (*mv*) that increased to 8.4 *mv* after 20 minutes of braindriving. Consistent with what one finds with alpha/theta neurofeedback training, when alpha amplitude increases theta tends to increase as well. In this case the theta amplitude increased by 15.4% (from 5.2 to 6.0 *mv*) that resulted in an increase in the theta/beta ratio of 14.3%.

## CASE KL

KL is a man in his 50s who was under treatment for posttraumatic diffuse body pain and severe sleep quality difficulties. His initial ratio of theta to SMR (13-15Hz) was 4.40 whereas a normative range is below about 2.50. At the session to be reported here, his starting theta/SMR ratio was 3.29. The braindriving protocol was to present the Alert theta-suppressing harmonic when theta amplitude exceeded the training threshold and to present the SMR enhancing harmonic when the amplitude of the SMR dropped below the training threshold. Baseline measurements at the start of the session indicated a theta amplitude of 5.6 *mv* and SMR amplitude of 1.7 *mv*. At the end of the session the theta amplitude remained unchanged at 5.6 *mv* but the amplitude of the SMR had increased to 4.0 *mv* for a ratio of 1.40. It is unusual to have changes this large but this case nicely shows that even with driving techniques the brain "knows what it needs", a concept most neurotherapists embrace, in that theta remained unchanged while SMR increased even thought both were driven. KL reported a marked improvement in the diffuse body pain at the next session.

## CASE TP

This little girl was under treatment for a serious learning disorder. One of the things we noticed in her QUICKQ was that the anterior cingulate gryus was hyperactive. Her ratio of hibeta (28-40Hz) to beta was .88 at intake whereas normative is .45 to .55. Hyperactivity of this structure is related to obsessive/compulsive forms of behavior including stereotypy of thought, problems "letting go" of thoughts, stubbornness, and of particular concern in situations of learning disorders, often resistance to accepting different approaches to learning.

Braindriving with young children usually is integrated into conventional biofeedback procedures because braindriving alone is rather boring. One simply sits there while the computer delivers sound stimuli about thirty percent of the time. As described above, braindriving can be integrated into conventional biofeedback with visual

icon displays. In this case when the icons were not moving the braindriving sound stimuli were presented. This particular session with TP was rather late in treatment. Her hibeta/beta ratio was down to .59 at the start of this session. The suppressing harmonic was 24.5Hz and the feedback game display was Pacman. The braindriving harmonic was presented, on average, 30% of the time. TP's end session hibeta/beta ratio had dropped to .53 that is well within normative range.

## CASE GR

One of the most exciting applications of braindriving is with clients who have limited capacity for volitional biofeedback. Although it is an axiom of neurotherapy that the brain learns even if the client is not paying attention nonetheless neurofeedback is compromised when the client has such limited capacities. Such clients include the more severe autistic spectrum disordered, psychotic, and brain injured. We have used braindriving with such clients many of whom have become capable of fully cooperative volitional neurofeedback. Braindriving protocols for such clients include suppression of hibeta and beta amplitude over the anterior cingulate gryus with autistic spectrum disordered children with a "hot midline", so-called "squash" protocols that suppress the amplitude of all frequencies from 2 to 25Hz for developmentally delayed and severe FAS children, and slow frequency suppress and "speed-up" alpha protocols for stroke clients.

GR spent the first 45 minutes of his first appointment screaming and thrashing on my office floor despite heroic efforts of his parents. Fortunately, one of my staff members is a most talented young woman who works magic with these seemingly unapproachable children. She was able to habituate GR to tolerate electrodes on his head and to remain relatively quiet for a few minutes at a time watching videos of animated cartoons. This habituation took several sessions after which we started the braindriving protocols and obtained a QUICKQ. The braindriving protocols included suppression of hibeta and beta over the frontal midline (Fz), "squash" over the frontal (F3 and F4) and central (Cz) areas, and suppression of theta amplitude over the occiput (O1 and O2) as well as centrally and frontally. There have been some remarkable changes in GR. He converses in sentences, albeit awkward and clipped, interacts with peers and, importantly, is capable of volitional neurofeedback where we are now addressing the anomalies found in his full 19 site QEEG. We started with the QUICKQ after GR was able to tolerate a single electrode and this miniQ guided our braindriving protocols. Once GR was able to tolerate the full cap we preceded to the full QEEG which is guiding his current treatment.

The above cases give examples of the use of braindriving in different clinical situations. I will end this section with a few other examples of braindriving under different conditions. Dr. Ochs told me that he found that he only needed a few seconds of his treatment to be clinically effective. In fact, he maintained that the effects could be mitigated if treatment continued beyond a few seconds! With braindriving as well we often find that the major effect occurs within the first few minutes and that prolonged treatment (20 to 30 minutes) yields little further gain. The following data are from a session with a severely traumatized woman in which the purpose of the session was to increase theta amplitude in the back of the brain (location O1). Her theta amplitude was 3.6 when she started. The data for the first 20 seconds of treatment indicated that the theta amplitude increased, at five-second intervals, as follows: 4.1, 4.6, 5.8, and 8.1. Thus, after 20 seconds of braindriving her theta amplitude increased from 3.6 to 8.1 *mv*. After an additional 20 minutes her theta amplitude increased to 10.1 *mv* indicating that the amplitude had increased 125% in twenty seconds and an additional 24.7% after an additional 20 minutes.

Braindriving can also be combined with other treatment procedures as well. The following data were obtained from a session in which Roshi 2 was being used. In this case the Roshi leads were on the frontal lobes (F3 and F4) and the Roshi stimulation was magnetic goggles. The purpose of Roshi is to reduce total brainwave amplitude but one might also want to enhance theta amplitude in conjunction with Roshi suppression of other brainwave frequencies. This is a case of a man in his 40s who was under treatment for anxiety, depression and sleep disturbance. In addition to the Roshi treatment, theta in the back of the brain (O1) was brain driven to either increase, or at least not decrease, the theta amplitude so as not to exacerbate the sleep problem. The end session

data indicated that alpha had decreased by 22.4%; beta by 17.5% but theta had increased by 10.5%. The theta/beta ratio at the start of the session was 1.00 and had increased to 1.34 by session end.

The final example is from a session in which the client, a woman in her 50s, had a braindriving session when she was heavily medicated with paroxetine (Paxil) and risperidone (Risperdal). At the start of the session her theta, alpha and beta amplitudes were 3.1, 2.9, and 8.2, respectively. At the end of the 30 minute session the amplitudes were 3.0, 2.9 and 8.3, respectively. Thus, braindriving appeared to be ineffective under this condition, a situation often encountered, in my experience, with conventional neurofeedback with heavily medicated clients.

In summary, braindriving has been found to be an extremely effective method for increasing the efficiency of neurotherapy. Combined with the very rapid and efficient QUICKQ intake procedure, neurotherapy can be a remarkably cost effective treatment option for a very wide range of disorders. Braindriving is simply applied learning theory in which stimuli with known and measurable effects on the central nervous system are made contingent upon a response, following a classical conditioning paradigm. This classical conditioning protocol can be combined with the operant conditioning properties of neurofeedback. One nice feature of the Braindryvr Cascade, for example, is that it can also be used to reinforce an operant, in addition to presenting stimuli in classical conditioning format. For example, the instrument can be programmed so that if the child produces a SMR response every few seconds, an electric train can be kept moving for a few seconds even though the SMR response is a brief operant. As described above, a second Braindryvr can be programmed to classically present the theta suppression harmonic whenever theta amplitude goes above the training threshold and this can be completely independent of the ongoing operant reinforcement of the SMR. In my opinion, this combination of volitional and non-volitional procedures is going to dramatically accelerate the development of neurotherapy as a primary treatment option for many disorders.

**SWINGLE 5-POINT QUICKQ**

**(RECORD: 3-7Hz; 8-12Hz; 16-25Hz)**

| EPOCH | @Cz | @O1 | @F4 | @F3 | @Fz | |
|---|---|---|---|---|---|---|
| 1 | EO | EO | EC | EC | EC | |
| 2 | EO | EO | EC | EC | EC | (RECORD: 2Hz; 28-40; |
| 3 | EC | EC | EC | EC | EC | 16-25Hz) |
| 4 | EO | EO | | | EC | |
| 5 | (READ | | | | EC | |
| 6 | OR | | | | EC | |
| 7 | COUNT) | | | | EC | (RECORD: 8-9Hz; |
| 8 | EO | (EO = EYES OPEN) | | | EC | 11-12Hz; 10Hz) |
| 9 | "ALERT" | (EC = EYES CLOSED) | | | EC | |
| 10 | "ALERT" | | | | EC | |

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# APPENDIX

## TECHNICAL NOTES

1. Ear ground and reference
2. Epoch length 15 seconds, shorter if necessary
3. Recording @ Cz is usually one continuous run of 10 epochs
4. Recording @ O1, F4 and F3 are usually in one interrupted run changing electrode position as necessary by pausing data collection
5. Recording @ Fz is usually one interrupted run changing filters by pausing data collection.
6. Cognitive challenge is either reading or counting
7. "Alert" is theta suppressing harmonic
8. Data are mean amplitudes unless artifacts indicate the use of medians
9. Band amplitudes calculated as square root of single Hz components squared
10. Unremarkable ranges, listed below, are normative guidelines, specific ranges may vary somewhat based on equipment, environmental conditions and certainly age of client.
11. The QUICKQ is ***not*** appropriate for assessment of stroke, seizure disorders, traumatic brain injury. QUICKQ is often appropriate for fist assessment of autistic spectrum, brain dysfunction to determine initial treatment protocols to be followed by QEEG.

## UNREMARKABLE CLINICAL RANGES

1. @Cz: mean theta/beta <2.2; alpha increase EC >30%; theta/beta ratio cognitive challenge <2.2 but no marked difference from mean and beta increase <20%; sum of all mean amplitudes, total power, (TP) <60.0
2. @O1: EO and EC theta/beta > 2.00; alpha increase EC > 50%
3. @F4 and F3: F4 = F3 in all bands, theta/beta ratios < 2.00; theta/alpha ratio 1.25-1.75; TP = and <60.
4. @Fz: 2Hz < 8.5; 28-40/beta .45 - .55; 28-40 & beta < 15.0; 8-9/11-12 < 1.30

## CLINICAL IMPLICATIONS OF REMARKABLE RANGES

The following clinical probes should be considered as suggestions for developing a behavioral profile of the client. Remarkable ranges do not validate a clinical diagnosis. Similar remarkable patterns can be associated with different clinical profiles. For example, developmental delay, fetal alcohol syndrome and some autistic spectrum profiles can have very similar remarkable EEG patterns. It is important to keep in mind, therefore, that the remarkable ranges indicate behavioral inefficiencies and not necessarily clinical diagnoses. Unique remarkable patterns are associated with some specific conditions, such as Common Attention Deficit Disorder (CADD) (item 1 under Cz, with no other remarkable ranges). Thus it is the treatment specificity afforded by identifying remarkable ranges rather than diagnostic labelling that makes the QUICKQ a valuable rapid intake procedure. The following suggested clinical probes are not exhaustive. The experienced clinician will identify many patterns associated with specific client complaints.

### @Cz

1. Mean theta/beta >2.2 and under cognitive challenge >2.2, probe for CADD
2. Mean theta/beta < 2.2, under cognitive challenge >2.2, probe for ADD and/or problem with poor reading comprehension/retention
3. Mean theta/beta >3.00, probe for AD(H)D
4. Limited or negative EC alpha increase, probe for visual processing
5. (memory) problem. If also negative @ O1 probe for traumatic stress
6. "Alert" theta suppression (relative to mean) if > 5% prescribe for home use
7. TP >> 60.0, Probe for developmental delay, autistic spectrum behavior, marked cognitive deficits

### @O1

1. Theta/beta EC <2.00, probe for poor stress tolerance, "racing" thoughts, anxiety. If <<2.00, probe for addictive behavior, GAD, and stress precipitated depression
2. If theta/beta EC < EO probe for sleep disturbance particularly sleep onset insomnia. If both EC and EO about = and <1.50 also probe sleep disturbance
3. If alpha EC increase minimal or negative and also at Cz, probe for traumatic stress
4. Theta/beta >3.00, probe for cognitive inefficiencies. Also found in some Asperger's patterns

### @F4 AND F3

1. Theta/beta >2.2, probe for cognitive inefficiencies
2. Theta/alpha <1.25, probe for frontal alpha ADD – problems with organization, sequencing, sustained focus. If theta/alpha <.50, also probe for fibromyalgia and sleep disturbance
3. F4 Beta > 20% of F3 beta and/or F4 theta/beta <20% of F3 theta/beta, probe for depression particularly in adults also probe for impulse control problems in children
4. F4 theta/beta > 30% F3 theta/beta, probe for emotional volatility or conversely restricted emotional range
5. TP>> 60.0, probe for developmental delays, autism spectrum disorders, memory/cognitive deficits in adults
6. F4 beta> 20% Of F3 beta and F4 theta > 20% of F3 theta probe for fibromyalgia/chronic fatigue, particularly when O1 theta/beta <1.50 @Fz

### @Fz

1. Delta (2Hz) >9.0, probe for cognitive deficits
2. 28-40Hz/beta < .45, probe for excessive passiveness
3. 28-40Hz/beta > .55, probe for stubborn behavior, obsessive/compulsive behavior; perseveration in autistic spectrum behaviors; assume hot midline (anterior cingulate gryus) in treatment of autistic spectrum behaviors

4. Implications of ratios in 2 and 3 above apply only if sum of amplitudes of 28-40Hz and beta <15. If latter summated amplitudes >15, but 28-40/beta is within normative range, probe for fretting and assume hot midline in treatment of autistic spectrum behaviors
5. 8-9/11-12 > 1.50, probe for cognitive inefficiency, age related deficits in memory and cognitive processing
6. 8-9/11-12 >> 1.50, probe for developmental delay, marked cognitive deficits, sleep disorder

*Dr. Swingle can be considered one of the founding fathers of Clinical Psychoneurophysiology, one of a select few, directly responsible for bringing Neurotherapy out of university labs and clinics to the general populace in the 1980's. His academic positions include, Professor of Psychology at the University of Ottawa from 1972 to 1997, Lecturer in Psychiatry at Harvard Medical School from 1991 to 1998, Associate Attending Psychologist at McLean Hospital (Boston), Head of the Clinical Psychophysiology Service McLean Hospital (Boston). Professor Swingle was also Clinical Supervisor at the University of Ottawa from 1987 to 1997 and Chairman of the Faculty of Child Psychology from 1972 to 1977. Dr. Swingle is a Registered Psychologist in British Columbia and is Board Certified in Biofeedback and Neurotherapy. He is actively involved in research and practice. His numerous publications including nine books and numerous peer reviewed journal publications. Some of which can be accessed at www.soundhealthproducts.com.*